CLAIMS

1. A test method, comprising:

squeezing a thermal interface material (TIM) sample at a plurality of different pressures at different times;

flowing heat through said TIM sample to create a thermal gradient between a heat source and a cold sink at each of said plurality of different pressures;

measuring temperatures at a plurality of points along said thermal gradient at respective ones of said plurality of different pressures; and

characterizing the thermal material properties of said TIM sample from calculations based on data obtained in the step of measuring.

2. The method of Claim 1, further comprising:

maintaining a constant pressure at each of said plurality of different pressures in spite of any thermal expansions of said TIM sample during a test.

3. The method of Claim 1, further comprising:

delaying the step of characterizing until temperature measurements in the step of measuring have reached a steady-state.

4. The method of Claim 1, further comprising:

delaying the step of characterizing until temperature measurements in the step of measuring should have reached a steady-state according to a previous trial run of said TIM sample.

5. The method of Claim 1, further comprising:

first making a trial run of said TIM sample to determine a particular set of pressures to use in the step of squeezing.

6. The method of Claim 4, further comprising:

first making a trial run of said TIM sample to determine a time delay needed for steady-state thermal conditions.

7. The method of Claim 1, further comprising:

first making a trial run of said TIM sample to determine heating and cooling requirements needed to establish said thermal gradient.

8. The method of Claim 1, further comprising:

computing a thermal resistance curve across intervening hot and cold blocks along said thermal gradient to extrapolate interface temperatures on opposite sides of said TIM sample; and

using such interface temperatures in a calculation of the thermal resistance of said TIM sample at each of said plurality of different pressures.

9. The method of Claim 8, further comprising:

determining a relationship between temperature and distance along each of the hot and cold blocks at steady-state with simple linear regression.

10. A materials testing system, comprising:

a fixture for placing a thermal interface material (TIM) between a hot and a cold copper block;

a press for squeezing the TIM between the hot and cold copper blocks at a plurality of pressures and for a plurality of durations according to a test profile;

a heater and cooler connected to the hot and cold copper blocks for creating a thermal gradient across the TIM;

a compensating controller adjusting the pressure applied to the TIM to be constant even though said TIM

sample expands and contracts with changes in its temperature;

a set of sensors for collecting temperature information from the hot and cold copper blocks during the steps of squeezing and creating; and

a computer for building a thermal-resistance-curve model of said TIM sample from data obtained in the step of collecting temperature information.

11. The system of Claim 10, further comprising:

a gauge for measuring the thickness of said TIM sample at room temperature and at a test temperature.

12. The system of Claim 10, further comprising:

a computer for calculating a net heat passing through said TIM sample to account for heat losses to the environment, and providing for a more accurate thermal resistance value to be estimated.

13. The system of Claim 10, further comprising:

a plurality of thermocouples strategically disposed in the hot and cold blocks;

a computer for calculating a least-squares fit, with R^2 better than 0.99, that means better than 99% of the variability in temperature is related to the differences in distance.

14. The system of Claim 10, further comprising:

a plurality of thermocouples strategically located and connected to provide data for a least-squares-fit for reducing a dependency on individual thermocouple accuracy.

15. A materials testing method, comprising:

placing a thermal interface material (TIM) in a fixture between a hot and a cold copper block with parallel opposing faces;

squeezing said TIM sample between said opposing faces at a plurality of pressures and for a plurality of durations according to a test profile;

creating a thermal gradient across the TIM with a heater and cooler connected to the hot and cold copper blocks;

adjusting the pressure applied to the TIM to be constant even though said TIM sample expands and contracts with changes in its temperature;

collecting temperature information from the hot and cold copper blocks during the steps of squeezing and creating; and

building a thermal-resistance-curve model of said TIM sample from data obtained in the step of collecting temperature information.

16. The method of claim 15, further comprising:

automatically positioning said parallel opposing faces to maintain parallelism between two contact surfaces so such precision is not operator dependent.

17. The method of claim 15, further comprising:

using no operator involvement in test fixture assembling and offline measurements.

18. The method of claim 15, further comprising:

applying pressure between said parallel opposing faces in the range of a few pounds to in excess of 400 pounds.

19. The method of claim 15, further comprising:

using cyclic tests for special evaluation without returning to a starting point.

20. The method of claim 15, further comprising:

non-uniformly heating said TIM sample with a secondary heating block.

21. The method of claim 15, further comprising:
heating TIM samples from both sides during a pre-conditioning phase to minimize wait time.

22. The method of claim 15, further comprising:
measuring TIM sample load and deflection simultaneously.

23. The method of claim 15, further comprising:
correlating TIM sample load and deflection.